Future Plans for Wireless Standards Development

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Identified Critical Needs for NASA

- RFID encoding standards
  - Must support both asset management and future RFID sensing needs
- RFID sensing
  - Targeted at low-data-rate applications
  - Assume EPCglobal Class 1, Gen 2 as over-the-air interface, more or less
  - All communication powered by interrogator
  - Data acquisition powered locally
    - Current applications probably require battery for most sensing and DAQ
    - Future move to local harvesting for both sensor and DAQ power
- High data-rate proximity communication and sensing
  - Ideally identify one standard for all support of high-data-rate sensing and comm in immediate proximity of vehicle/habitat
  - Definitely needs to support meshing and multihop
  - Initial effort could exclude MIMO but should cover that eventually
  - WiFi focus still makes most sense if acceptable for low-power applications (more on that later)

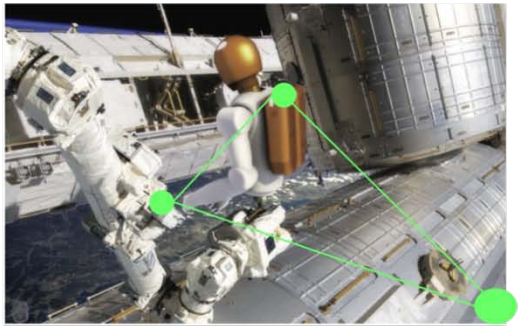
JSC Statement on Need for Additional NASA WWG Funding

- **High-Data-Rate Wireless Proximity Com**
  - The recent report on the EVA suit flooding incident this summer has resulted in a directive by the administrator to implement a solution plan that addresses all recommendations in the report, including a recommend high-data-rate telemetry link from the suit to ISS. This is precisely the sort of specification that was proposed for work in SOIS WIR in the past but was tabled due to lack of resources within both ESA and NASA. ISS is also very interested in proximity communications that enables higher payload data rates, and Orion has a need for high data rate proximity communications for video telemetry. Lack of prototype funding has prevented us from staying ahead of ISS and Orion proximity communication needs. NASA is again proposing starting work on a book to specify recommended practices for high-data-rate proximity communication, which should ideally provide the framework for solutions to problems such these. The current level of NASA Data Standards support for SOIS WIR in FY14 is not sufficient to support the requisite prototyping activity for high data rate proximity communication in addition to other existing high priority activities such as RFID encoding standards for autonomous logistics management. Recommended future prototyping for extensions of commercial standards based on advanced high rate technologies includes multiple-input, multiple-output (MIMO) communication, which is not currently supported and also is a critical need.

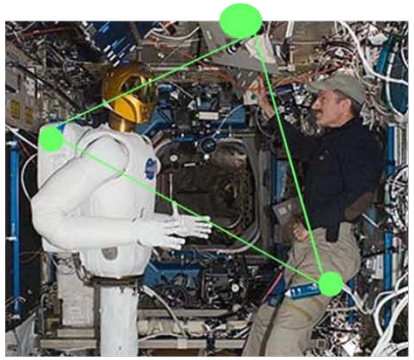
High Data-Rate Proximity Communication and Sensing Use Cases

- EVA
  - Telemetry, audio, and video data from suit
  - Must support mesh with point-to-point link between astronauts or astronauts and robotic assistants
  - Need to have mesh relay capability to reduce or eliminate outages or extend range of EVA
- Tele-Robotics
  - Telemetry, video
  - Video may need to be raw data to minimize latency for critical control
- Automated rendezvous and docking
  - Telemetry, audio, and video
  - Video may need to be raw data to minimize latency
- Sensor networks
  - High-bandwidth telemetry data from internal or external sensors
  - High data-rate backhaul for low data-rate sensor network gateways
- External payloads
  - More and more payloads wanting wireless access
  - Many payloads have high data-rate requirements
- Teleconferencing between vehicles

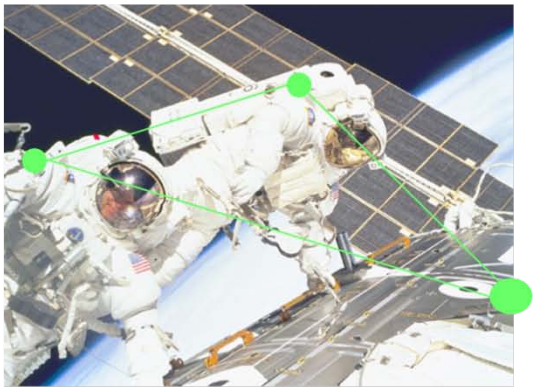
High Data-Rate Communication and Sensing Examples



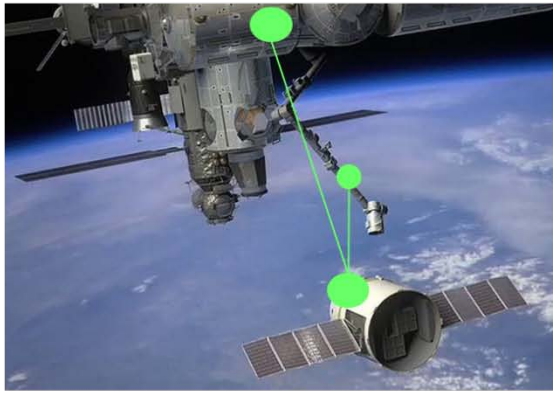
External unmanned Tweets and Images



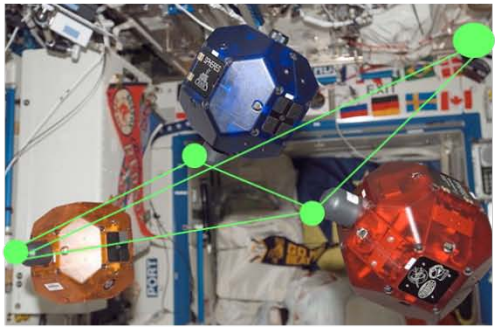
Internal intercom, payloads



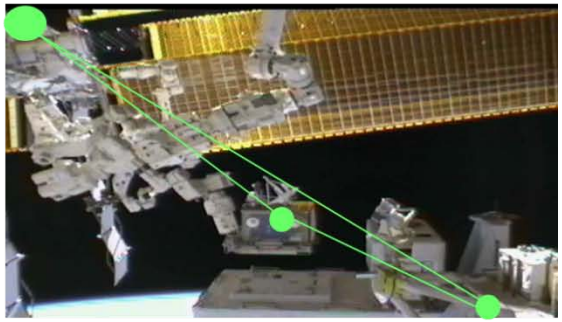
Crew EVA audio and video



Free-flyers, Visiting Vehicles



Internal Payloads , Free-flyers



External Payloads

High Data-Rate Communication and Sensing Examples

Laptops, Personal Devices, Intercom, Payloads, Gateways

Suggestions for High-Data-Rate Proximity Standards Development

- Focus on WiFi initially but consider future integration with LTE/EPC networks
- Consider requirement for DTN compatibility
- Consider best layer for meshing implementation
  - 802.11 meshing is layer 2 exclusively
  - Meshing could be done in application layer overlay along with DTN
- Consider separate power-constrained and non-power-constrained specifications
  - Current WiFi implementations all optimized to operate at highest possible data rates by ignoring need for energy efficiency
  - In general, to be even somewhat energy efficient, desired information data rate cannot exceed twice the available bandwidth
  - Quite possible to operate at lower data rates in WiFi system with much higher energy efficiency and still far exceed 802.15.4 data rates